

WHAT IS CLAIMED IS:

1. An assembling method of a capsule medical apparatus including a sealed capsule having an illuminating unit, an image pick-up unit for picking up an image of a portion illuminated by the illuminating unit, and an objective optical system in front of the image pick-up unit, the assembling method comprising:

a positioning step of positioning a relative position of a reference position of a fixing frame of the objective optical system so that it matches a reference position of an image area of the image pick-up unit; and

a fixing step of, after the positioning step, fixing the image pick-up unit and the fixing frame so that a reference down-surface of the fixing frame comes into contact with a top surface of the image pick-up unit.

2. A capsule medical apparatus comprising:

an illuminating unit;

an image pick-up unit which picks up an image of a portion illuminated by the illuminating unit;

an objective optical system in front of the image pick-up unit; and

a sealed capsule which seals and incorporates the illuminating unit, the image pick-up unit, and the objective

optical system,

wherein the capsule medical apparatus has the structure in which positioning processing is performed so that a relative position of a reference position of a fixing frame of the objective optical system matches a reference position of an image area of the image pick-up unit, and the image pick-up unit and the fixing frame are fixed by touching a reference down-surface of the fixing frame to a top surface of the image pick-up unit.

3. A capsule medical system comprising:

a capsule medical apparatus comprising,

an illuminating unit,

an image pick-up unit which picks up an image of a portion illuminated by the illuminating unit,

an objective optical system in front of the image pick-up unit, and

a sealed capsule which seals and includes the illuminating unit, the image pick-up unit, and the objective optical system; and

a display device which can display picked-up images of a plurality of the capsule medical apparatuses,

wherein the capsule medical apparatus has the structure in which positioning processing is performed so that a relative position of a reference position of a fixing frame

of the objective optical system matches a reference position of an image area of the image pick-up unit, and the image pick-up unit and the fixing frame are fixed by touching a reference down-surface of the fixing frame to a top surface of the image pick-up unit, and the picked-up images of the capsule medical apparatuses are displayed on the display device.

4. An assembling method of a capsule medical apparatus according to Claim 1, wherein the reference position of the image area is on a corner portion around the image area or on at least a part of peripheral circuits of the image pick-up unit, such as a bonding pad formed in the same processing as the formation of the image area.

5. A capsule medical apparatus according to Claim 2, wherein the reference position of the image area is on a corner portion around the image area or on at least a part of peripheral circuits of the image pick-up unit, such as a bonding pad formed in the same processing as the formation of the image area.

6. An assembling method of a capsule medical apparatus according to Claim 1, wherein the fixing frame has a shape by which a corner portion around the image area or at least

a part of peripheral circuits of the image pick-up unit is viewed from the top.

7. A capsule medical apparatus according to Claim 2, wherein the fixing frame has a shape by which a corner portion around the image area or at least a part of peripheral circuits of the image pick-up unit is viewed from the top.

8. An assembling method of a capsule medical apparatus according to Claim 1, wherein the fixing frame has a leg portion for fixing, which is extended to a part of a side surface having no connecting terminals such as a bonding pad of the image pick-up unit, and the fixing frame fixes the leg portion for fixing to a fixing substrate of the image pick-up unit.

9. A capsule medical apparatus according to Claim 2, wherein the fixing frame has a leg portion for fixing, which is extended to a part of a side surface having no connecting terminals such as a bonding pad of the image pick-up unit, and the fixing frame fixes the leg portion for fixing to a fixing substrate of the image pick-up unit.

10. An assembling method of a capsule medical

apparatus according to Claim 1, further comprising:

positioning step of positioning a movable frame in the optical axis direction by advancing or returning it to a guide portion in the optical axis direction, the movable frame to which the objective lens is fixed, the guide portion formed upstream of the fixing frame and guiding the movable frame.

11. A capsule medical apparatus according to Claim 2, further comprising:

positioning step of positioning a movable frame in the optical axis direction by advancing or returning it to a guide portion in the optical axis direction, the movable frame to which the objective lens is fixed, the guide portion formed upstream of the fixing frame and guiding the movable frame.

12. A capsule medical apparatus according to Claim 2, further comprising:

an electrical circuit block having an outer shape which is slightly smaller than the inner diameter of a capsule-shaped exterior, the capsule-shaped exterior having a plurality of electrical substrates with different functions, the electrical substrates being electrically conductive and being mechanically fixed via a connecting member in parallel

with each other.

13. A capsule medical apparatus according to Claim 2, wherein an antenna for radio transmission is arranged in parallel with the optical axis of the objective optical system.

14. A capsule medical apparatus according to Claim 2, wherein the illuminating unit comprises a plurality of light emitting diodes, and the control operation is performed so that light emitting timings of the plurality of light emitting diodes are lit on intermittently at different timings within an exposure time of the image pick-up unit.

15. A capsule medical apparatus comprising an electric circuit block having an outer shape slightly smaller than the inner diameter of a capsule-shaped exterior, the capsule-shaped exterior having a plurality of electrical substrates with different functions, the electrical substrates being electrically conductive and being mechanically fixed via a connecting member in parallel with each other.

16. A capsule medical apparatus according to Claim 15, wherein the connecting member comprises a plurality of pins

which can be arranged at the same interval or at an interval larger than that between plurality of soldering balls or than the height of mounting parts of a plurality of substrates.

17. A capsule medical apparatus according to Claim 15, wherein the connecting member is an MID (Molded Interconnect Devices) obtained by three-dimensionally forming thereon a plurality of connecting terminals or a lead frame formed integrally to a coupling portion which can easily be cut off after connection.

18. A capsule medical apparatus according to Claim 15, wherein a pad, to which the connecting member of one electrical substrate is attached, is extended to the outer shape of the substrate.

19. A capsule medical apparatus according to Claim 15, wherein a plurality of electrical substrates are overlapped and are fixed, and are soldered by flowing them to a flow furnace in a lump.

20. A capsule medical apparatus according to Claim 15, wherein the electrical substrate has a fitting hole for fitting into the connecting member.

21. A capsule medical apparatus according to Claim 15, wherein a battery for driving is arranged to the rear end side of the electrical circuit block and the capsule medical apparatus has a flexible substrate which electrically connects the battery and the electrical circuit block.

22. A capsule medical apparatus according to Claim 15, wherein a connecting end comprises a plurality of soldering balls for electrically connecting the plurality of electrical substrates, and the inclination of the electric substrates can be prevented by connecting at least two sides of the plurality of electrical substrates.

23. A capsule medical apparatus according to Claim 15, wherein the electrical substrates are substantially circular or substantially polygonal, and have substantially the same maximum outer shapes.

24. A capsule medical apparatus according to Claim 15, wherein the electric circuit block has at least an image pick-up unit, a first electric substrate having a cave portion for fixing another electric part to the rear surface of the image pick-up unit, a second electric substrate having a cave portion for fixing a control portion for

controlling at least the image pick-up unit, and a connecting terminal for connecting the first and second electric substrates.

25. A capsule medical apparatus according to Claim 15, wherein two electric parts having different functions are layered and are mounted on one surface of at least one of the electric substrates.

26. A capsule medical apparatus according to Claim 15, wherein an antenna for radio transmission is arranged substantially in parallel with the optical axis of the objective optical system.

27. A capsule medical apparatus according to Claim 15, wherein the illuminating unit comprises a plurality of light emitting diodes, light emitting timings of the plurality of light emitting diodes are controlled to be deviated within an exposure time of the image pick-up unit and to intermittently be lit on.

28. An assembling method of a capsule medical apparatus having a sealed capsule, the sealed capsule having an illuminating unit, an image pick-up unit for picking up an image of a portion illuminated by the illuminating unit,

and an objective optical system in front of the image pick-up unit, the assembling method comprising the step of:

connecting one electric substrate for fixing the image pick-up unit to another electric substrate having a function different from that thereof by using connecting terminals at an interval less than that between the connecting terminals while regulating the outer diameters of the electric substrates.

29. An assembling method of a capsule medical apparatus having a sealed capsule, the sealed capsule having an illuminating unit, an image pick-up unit for picking up an image of a portion illuminated by the illuminating unit, and an objective optical system in front of the image pick-up unit, the assembling method comprising the step of:

mounting the image pick-up unit on the sealed capsule so that when the center of an image pick-up sensor of the image pick-up unit is deviated from the center of an image area of the image pick-up sensor, the center of the image area is substantially in the center of an electric substrate for fixing the image pick-up sensor.

30. A capsule medical apparatus comprising:

an illuminating unit;

an image pick-up unit for picking up an image of a

portion illuminated by the illuminating portion;
an objective optical system in front of the image pick-up unit;
a transparent cover which is substantially hemispherical in front of the objective optical system; and
a sealed capsule which seals and incorporates, together with the transparent cover, the illuminating unit, the image pick-up unit, and the objective optical system,
wherein a positioning unit is formed for positioning operation by touching a substrate surface of the illuminating unit to an inner surface of the transparent cover so that the positioning unit is fixed to the circumferences of the illuminating unit and the objective optical system after adjusting optical axes of the objective optical system and the image pick-up unit to be in-focus, and so that the center of curvature of the transparent cover in front of the circumferences of the illuminating unit and the objective optical system, a pupil position of the objective optical system, and a light emitting position of the illuminating unit are fixed to a restricted position for preventing flares.

31. A medical method for examination, curing, and treatment in a body using a capsule medical apparatus, the capsule medical apparatus having:

an illuminating unit;

an image pick-up unit for picking up an image of a portion illuminated by the illuminated unit;

an objective optical system in front of the image pick-up unit; and

a sealed capsule which seals and incorporates the illuminating unit, the image pick-up unit, and the objective optical system,

the medical method comprising the steps of:

forming the illuminating unit by a plurality of light emitting diodes; and

controlling light emitting timings of the plurality of light emitting diodes so that they are deviated within an exposure time of the image pick-up unit and are intermittently lit on.